

Research Article

Biometrical Analysis of Capsules per Plant in Salinity in Linseed Plant

Dharmendra Pal Singh^{1*}, K.P. Singh¹ and Jagriti Sharma²

¹Department of Botany, R.B.S. College, Agra-282002 (U.P.), India.

²Department of Microbiology, School of Life Sciences, Khandari Campus, Dr. B.R. Ambedkar University, Agra-282002 (U.P.), India.

Abstract: The main objective of breeding linseed is the improvement of yield potential at the new cultivars; so that they became more desirable agronomically and economically, viz. higher yield improved the content and the quality of oil resistance, decreased pests, early maturity fertilizers responsiveness and genetics extension of seed filling period. The present study deals with the measurement of capsules per plant under salinity conditions.

Keywords: *Linum usitatissimum*, Hybrid seeds, Salinity, Varieties, Cultivars.

1. Introduction

Considerable work in the past years has been done on breeding for diseases resistance high yields and oil content but no desired results have been obtained with regards to salinity tolerant varieties for salt affected soils of the country. According to an estimate (Abrol, 1986), about 15 percent of arable land in India is affected by soil salinity and alkalinity in the arid and semi-arid regions. Also over 50 percent of total irrigated area is salt-affected due to continuous use of poor quality irrigation water (Tripathi and Pal, 1980). The crops are grown with such water generally give a poor return to growers. It has been noted by the agricultural scientists (Pal, 1983) that salt change will increase in future. Thus unless suitable management practices and high-yielding salt tolerant varieties are not incorporated in salt-affected areas, productivity is not going to improve.

Singh *et al.*, (1981) observed the effects of exchangeable sodium on the yield, chemical composition and oil content of safflower and linseed. With increasing ESP, maturity was enhanced in safflower but delayed in linseed. Grain yield and dry matter of safflower regularly decreased with increasing ESP, but a significant reduction in linseed only above on 13 ESP 50 percent reduction in grain yield was observed at 14 ESP in safflower and 26 ESP in linseed. With increasing ESP the Mg content was decreased in safflower and Ca decreased and Na increased in both crops. There was no effect of ESP on oil content, P,

Mn, Zn, Fe, Cu and K of plants parts in both the crops. In the mature stem, a ratio of Ca + K to Na of 1.7 in safflower and 2.7 in linseed were found to be critical for grain yield. The safflower was more sensitive to soil sodicity than linseed in the field. Bangal *et al.*, (1984) studied the germination tolerance of 4 safflowers cultivars with NaCl, NaHCO₃, Na₂SO₄ and CaCl₂ salts. One variety showed maximum tolerance to all these salts. Highest toxicity was shown by HCO₃ ions, followed by SO₄ and Cl. The toxic effects of other salts were reduced in the presence of NaCl. However, found CaCl₂ as more detrimental for seed germination in safflower than NaSO₄, NaHCO₃, and NaCl.

2. Materials and Methods

The material for this experiment comprises 10 selected varieties of linseed (*Linum usitatissimum* L.) out of 50 varieties for their relative salinity tolerance. Seeds of 50 varieties of linseed were obtained from the Coordinator, All India Coordinated Research Project (Linseed), Chandrashekhar Azad University of Agriculture and Technology, Kalyanpur, Kanpur. Preliminary screening of these varieties against various levels of salinity was done at R.B.S. College Agriculture Research Farm, Bichpuri, Agra and 10 varieties showing relative tolerance to salinity were selected for the present study during the 2002-2003 crop season.

The seeds of 10 selected varieties namely Neelum, DPL-121, T-65, S-36, Hira, K-2, Gaurav, Subhra, Neela

*Corresponding author:
E-mail: microjagriti@gmail.com.

and LCM-926 were sown in well laid out plots at R.B.S. College Agriculture Research Farm, Bichpuri, Agra on during 2002-2003 crop season and 2003-04 crop season, in a "Split Plot Design" with three replications. The distances between row to row and plant to plant were kept 30cm and 7cm respectively. All possible reciprocal crosses were attempted amongst 10 varieties of linseed at best water and saline water conditions in 2002-03. Seventy-one hybrids thus generated at best water and 66 hybrids under saline water were sown during 2003-04. The data were recorded from each plot on the randomly selected plants to study following characters during both crop seasons. Germination and Plant height was measured 15 days before harvest by taking vertical height starting from soil surface to the tallest shoot.

2.1 Experimental site, Climate and weather conditions

The experiment was conducted at R.B.S. College Agriculture Research Farm, Bichpuri, Agra for two consecutive rabi crop seasons. During both crop seasons, the experimental site remained the same. The depth of the groundwater table remained around 14.00 meters from soil surface. The R.B.S. College Agriculture Research Farm is located at 28.3E longitudes and 169.5 m above mean sea level. The climate is semi-arid and sub-tropical with hot dry summers and severely cold winters. In summers, temperature goes up to 46°C with desiccating westerly wind and in winters it falls up to 1°C with occasional ground frost. The average annual rainfall is about 650mm of which 80 percent is received during July and August.

Physiochemical characters of the Experimental soil before sowing.

S. No.	Particulars	
1.	Texture	Sandy Loam
2.	Saturation (%)	26.25
3.	Hydraulic conductivity (cm/hr)	1.50
4.	Available N	79 Kg/ha
5.	Available P ₂ O ₅	18.65 Kg/ha
6.	Available K ₂ O	456 Kg/ha
7.	pH	8.18
8.	EC (dS/m)	1.95
9.	Percentage of CaCO ₃	0.51

During both crop seasons, i.e. 2002-03 and 2003-04 three salt irrigations were applied. First irrigation was given before 8 days of sowing, second after 40 days and third after 80 days of sowing. The water for three irrigations was prepared by dissolving six salts viz. NaCl, Na₂SO₄, Na₂CO₃, MgSO₄, MgCl₂, CaCl₂ in the canal water and different levels of EC (8, 10 and 12) were maintained through required quantity of salts.

Salinity with 4 levels:

S₀ = best water; S₁ = EC-8; S₂ = EC-10; S₃ = EC-12.

Varieties:

P₁ = Neelum; P₂ = DPL - 121; P₃ = T -65; P₄ = S -36; P₅ = Hira; P₆ = K -2; P₇ = Gaurav; P₈ = Subhra; P₉ = Neela; P₁₀ = LCM - 926.

2.2 Capsule plant

Total number of fertile capsules on each plant were counted at the time of harvesting.

2.3 Statistical analysis

The experimental observations recorded on the characters mentioned earlier have been subjected to the following biometrical analysis in hybrid population of two consecutive years and F₂ population of one year only in the present investigation.

Table 1. Effect of various salinity levels on no. of capsules plant⁻¹ in ten varieties of Linseed at two successive crop seasons.

Salinity Levels	Crop Season	
	2002-03	2003-04
S ₀	78.60	61.60
S ₁	94.20	35.80
S ₂	124.00**	35.15**
S ₃	112.25	30.70**
C.D. at 5%	37.15*	6.87*
C.D. at 1%	52.84**	9.78**

Table 2. Average number of capsules plant⁻¹ of each variety at salinity conditions from S₁ to S₃.

Varieties	Crop Season	
	2002-03	2003-04
P ₁	66.40	34.50
P ₂	76.80	37.00
P ₃	84.50	47.65**
P ₄	163.35**	56.00**
P ₅	74.00	39.75
P ₆	96.25	42.00**
P ₇	116.85**	42.15**
P ₈	104.20*	40.00*
P ₉	122.83**	44.90**
P ₁₀	107.50**	40.60*
C.D. at 5%	30.25*	5.19*
C.D. at 1%	39.74**	6.81**

Table 3. Effect of three levels of salinity on ten varieties of Linseed for number of capsules plant⁻¹ during 2002-03.

Varieties	S ₀	S ₁	S ₂	S ₃
P ₁	51.55	99.70	72.00	45.40
P ₂	84.00	87.50	48.10	72.75
P ₃	99.40	80.93	121.36	86.00
P ₄	105.00	140.80	241.60**	161.34**
P ₅	75.70	55.90	88.00	79.00
P ₆	79.70	108.90	108.50	94.05
P ₇	67.00	99.05	155.38*	151.67**
P ₈	65.48	62.45	164.50*	109.82
P ₉	103.89	122.45	67.14	173.00**
P ₁₀	55.50	73.88	173.15	149.65**
C.D. at 5%	74.02*			
C.D. at 1%	97.29**			

3. Results and Discussion

Table 1 show that the number of capsules plant⁻¹ increased at all salinity levels under the timely sown condition and decreased under late sown condition. The decrease was significant at all salinity levels whereas a significant increase was noted at S₂. Table 2 shows the effect of individual variety on capsules plant⁻¹ at various salinity levels. It is clear from this table that the number of capsules plant⁻¹ increased during both crop seasons in all cultivars against P₁. A significant difference for both crop seasons was, however, observed in varieties P₄, P₇, P₈, P₉, and P₁₀. When compared to interaction of various salinity levels to individual linseed variety, it is observed that only P₄ showed a significant increase at most salinity levels for capsules plant⁻¹ during both crop seasons (Table 3 and 4) whereas all other varieties showed fluctuating trends at different salinity levels during both crop seasons. Significant increase in

capsule plant⁻¹ in varieties P₇, P₉ and P₁₀ at highest salinity (S₃) was an interesting phenomenon.

Table 4. Effect of three levels of salinity on ten varieties of Linseed for number of capsules plant⁻¹ during 2003-04.

Varieties	S ₀	S ₁	S ₂	S ₃
P ₁	44.25	28.62	33.56	30.35
P ₂	69.00**	22.15	27.00	24.07
P ₃	66.25**	42.00*	39.15	34.28
P ₄	74.45**	55.40**	51.73**	47.53**
P ₅	71.05**	32.68	29.06	25.23
P ₆	74.00**	39.50	28.00	23.30
P ₇	51.25	35.00	42.15	35.50
P ₈	43.50	34.46	28.76	23.80
P ₉	73.33**	37.00	37.00	32.17
P ₁₀	48.00	37.06	35.60	31.15
C.D. at 5%	12.68*			
C.D. at 1%	16.66**			

Table 5. Comparative effect of salinity on no. of capsules plant⁻¹ in the hybrids of Linseed during 2003-04.

Crosses	S ₀	S ₁	Crosses	S ₀	S ₁
P₁ x P₂	-66.20	-20.00	P₇ x P₁	+52.00	+44.32
x P ₃	-44.75	-35.10	x P ₂	+12.70	-54.10
x P ₄	+93.50	+83.50	x P ₃	+69.00	+58.00
x P ₅	-53.50	-20.30	x P ₄	+75.50	+60.30
x P ₆	-69.60	+55.60	x P ₅	-56.76	-
x P ₇	+68.20	+59.50	x P ₆	-59.00	-35.90
x P ₈	+64.00	+38.00	x P ₈	+56.10	+58.30
x P ₉	+86.20	+67.90	x P ₉	-73.00	-37.00
x P ₁₀	+111.30	-20.00	x P ₁₀	+53.70	+39.50
P₄ x P₁	-42.20	-49.10	P₈ x P₁	-43.00	+56.00
x P ₂	+48.70	-35.60	x P ₂	-52.70	+47.10
x P ₃	+79.00	-43.70	x P ₃	-78.00	+44.65
x P ₅	-53.10	-48.30	x P ₄	+110.00	-39.20
x P ₆	-58.00	+62.90	x P ₅	-41.20	+38.00
x P ₇	-63.00	-37.10	x P ₆	-32.50	-
x P ₈	-70.00	+67.90	x P ₇	+94.50	+44.30
x P ₉	-48.00	-43.50	x P ₉	-50.10	+69.10
x P ₁₀	+139.40	-37.35	x P ₁₀	-41.20	-
P₅ x P₁	-33.00	-	P₉ x P₁	-52.90	+56.50
x P ₂	-42.15	+44.50	x P ₂	-51.80	+39.50
x P ₃	-46.30	-36.10	x P ₃	-	+45.00
x P ₄	-66.00	+75.20	x P ₄	+86.20	-
x P ₆	-49.30	-38.00	x P ₆	-56.30	-35.30
x P ₇	-55.70	+57.10	x P ₇	-72.50	+60.60
x P ₈	-49.60	-31.50	x P ₈	-59.50	+40.00
x P ₉	-69.40	+56.70	x P ₉	+80.35	-32.30
x P ₁₀	-46.10	-30.60	x P ₁₀	+131.80	+40.50
P₆ x P₁	-67.00	+54.75	P₁₀ x P₁	+57.00	+65.50
x P ₂	+200.20	+57.50	x P ₂	-69.00	+40.00
x P ₃	+107.30	+92.00	x P ₃	-57.00	+57.20
x P ₄	+140.10	-44.10	x P ₄	-64.20	+65.50
x P ₅	+106.50	-30.00	x P ₅	-56.30	+44.20
x P ₇	+165.20	+80.00	x P ₇	-62.00	+50.10
x P ₈	+77.30	+47.10	x P ₈	+81.70	-
x P ₉	+164.30	-29.15	x P ₉	+91.10	+56.20
x P ₁₀	+85.00	-27.00	x P ₁₀	-62.30	+47.80

The performance of hybrid seeds obtained from reciprocal crosses of ten cultivars of linseed was studied for number of capsules plant⁻¹ under best water and saline water (8 dS/m) conditions. The data recorded are presented in Table 5. It is seen that number of capsules plant⁻¹ was increased in 29 hybrids over their best parent in best water conditions and in 41 hybrids under saline conditions. The maximum number of capsules plant⁻¹ was observed in the hybrid involving the parent P₆, P₂ under best water conditions followed by P₆ x P₂ under best water conditions followed by P₆ x P₉ and P₆ x P₇. On the other hand, although salinity reduced the number of capsules plant⁻¹ in general, positive heterosis for this character was noted among 41 hybrids of which P₆ x P₃ had a maximum value of 91 followed by P₁ x P₄ and P₆ x P₇. In general, the number of capsules plant⁻¹ increased at all salinity levels in timely sown crop and decreased in late sown crop due to the corresponding behaviour of primary and secondary branches. This was mainly due to a reduction in a growth period. When compared to the interaction of individual variety at different salinity levels variety S-36 performed better than all other varieties in the times as well as late sown the crop. A significant increase in capsule number at higher salinity levels of timely sown crop in varieties Neela. Garima and LCM-926 was a noteworthy feature (it appears that cultivars having smaller seeds had a tendency to produce more capsules plant⁻¹). Positive heterosis for a number of capsules plant⁻¹ over their best parent was noted in 29 hybrids under best water and in 41 hybrids under 8 dS/m salinity condition. Variety K-2 in best water and LCM-926 in saline water, when used as female parents, had contributed positively for this parameter in a maximum number of crosses. The present findings will be helpful in exploring salinity effects on a number of capsules per plant which will further help in finding best ways to enhance the linseed production.

References

- [1]. Herchi, W., Harrabi, S., Rochut, S., Boukhchina, S., Kallel, H. and Pepe, C. (2009). Characterization and quantification of the aliphatic hydrocarbon fraction during linseed

development (*Linum usitatissimum* L.). *J. Agric. Food Chem.*, 57: 5832–5836.

- [2]. Bangal, D.B., Patil, V.A. and Jadhav, B.B. (1984). Relative salt tolerance of safflower cultivars (*Carthamus tinctorius* L.) at germination. *Agricultural Science Digest*, 4(4): 211-214.
- [3]. Khan, A.Z., Shah, P., Khalil, S.K., Zubair, M., Khan, H., Nigar, S., Perveen, S., Shah, M.K. and Amanullah (2011). Seed quality and vigor of soybean cultivars as influenced by canopy temperature. *Pak. J. Bot.*, 43(1): 643-648.
- [4]. Kumar, R. and Kumawat, N. (2014). Effect of sowing dates, seed rates and integrated nutrition on productivity, profitability and nutrient uptake of summer mungbean in Eastern Himalaya. *Archives of Agronomy and Soil Science*, 60(9): 1207-1227.
- [5]. Montgomery, D.C. (2001). Design and Analysis of Experiments. 5th Ed. John Willy and Sons, New York. p. 64-65.
- [6]. Munshi, S.K. and Kumari, A. (2006). Physical characteristics of silique and lipid composition of seeds located at different positions in mature mustard inflorescence. *J. Sci. Food Agric.*, 64(3): 289-293.
- [7]. Singh, D.N., Bohra, J.S. and Singh, J.K. (2013). Influence of NPK, S and variety on growth, yield and quality of irrigated linseed (*Linum usitatissimum*). *Indian Journal of Agricultural Sciences*, 83(4): 456-458.
- [8]. Singh, T., Singh, V.K., Singh, Y. and Singh, M.K. (2007). Effect of sowing dates, seed rates and sulfur levels on growth, yield, quality and moisture use of rainfed linseed. *Environment and Ecology*, 25: 978-982.
- [9]. Stražil, Z. and Vorlíček, Z. (2004). Effect of soil and weather conditions and some agricultural practices on yield and yield components in linseed (*Linum usitatissimum* L.). *Scientia Agriculturae Bohemica*, 35: 52–56.
- [10]. Yeo, A.R., Yeo, M.E., Flowers, T.J. (1988). Selection of lines with high and low sodium transport from within varieties of an inbreeding species: rice (*Oryza sativa* L.). *The New Phytologist*, 110(1): 13–19.